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H Amarananjundeswara
Horticultural Research and
Extension Station,
Somanahallikaval, Hassan,
Karnataka, India

YH Suhas
Department of Vegetable
Science, College of Horticulture,
Kolar, Karnataka, India

JS Aravinda Kumar
Department of Vegetable
Science, College of Horticulture,
Mysuru, Karnataka, India

R Veere Gowda
Division of Vegetable Crops,
IIHR, Bangalore, Karnataka,
India

TB Manjunatha Reddy
Department of Plant Pathology,
College of Horticulture, Kolar,
Karnataka, India

Corresponding Author:
JS Aravinda Kumar
Department of Vegetable
Science, College of Horticulture,
Mysuru, Karnataka, India

Evaluation of onion (*Allium cepa* L.) genotypes for growth and yield parameters under eastern dry zone of Karnataka

H Amarananjundeswara, YH Suhas, JS Aravinda Kumar, R Veere Gowda and TB Manjunatha Reddy

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Abstract

A field experiment was conducted to know the performance of onion (*Allium cepa* L.) genotypes in Eastern Dry Zone of Karnataka during 2015-16 at College of Horticulture, Kolar, Karnataka. Twenty five genotypes (13 varieties, 10 hybrids and 2 synthetics) were collected and evaluated in *Rabi* season. The research work was carried out to identify the elite genotypes suitable for *Rabi* season cultivation for higher bulb yield. The performance of the different genotypes with respect to growth and bulb yield were studied. The hybrid Flare (38.50 t/ha), Super Flare (37.00 t/ha) and S-780 (36.40 t/ha) were found best for obtaining quality bulb yield. In the studies, onion F₁ hybrids were found to be superior to the synthetics and open pollinated varieties for higher bulb yield. Therefore, it is concluded that onion F₁ hybrids need to be popularise for commercial cultivation for increasing productivity in the country.

Keywords: Onion, evaluation, hybrids, bulb yield

Introduction

Onion (*Allium cepa* L.), is an important species belonging to family Alliaceae and its chromosome number 2n=16. It is most widely grown and popular vegetable crop among the Alliums. Onion is considered to be the second most important vegetable crop grown in the world after tomato. It is an indispensable item in every kitchen as vegetable and condiment used to flavour many of the food stuffs. Therefore, onion is popularly referred as 'Queen of the kitchen'. In addition, onion is used as salad and pickle. In recently onion is being employed by processing industry to a greater extent for preparation of dehydrated onion products like powder and flakes.

Even though India stands in second place with respect to the production of onion in the world next to china, however the productivity is very low as compared to other advanced countries. The higher productivity could be achieved by selection of proper varieties specific to areas, appropriate agronomical practices such as balanced nutrition, optimum water management as well as need based plant protection measures, harvesting, post-harvest handling of the produce, etc. Onion cultivars show wide variation in their yielding ability, when grown over varied agro-climatic conditions. Besides the yield and quality of onion depends upon soil, climatic conditions and variety or hybrid used. Of different cultivars have different soil and climatic requirements for their optimum performance. India being a vast country with varied agro-climatic regions, a single variety or hybrid may not be suitable for all the agro-climatic conditions. Hence, new varieties or hybrids need to be introduced or evolved for specific regions.

Materials and Methods

The present investigation was carried out at the Department of Vegetable Science, College of Horticulture, Kolar during *Rabi* 2015-16. An experimental materials comprised of twenty five genotypes (13 varieties, 10 hybrids and 2 synthetics) were collected from different sources across the country. An experiment was laid out in a randomized complete block design with two replications. An optimum spacing of 15 cm×10 cm between rows and plants was adopted with a plot size of 2.0 m x 1.5 m. All the recommended cultural practices were followed to

maintain good growth of the crop. An observations were recorded on five randomly selected plants in each genotype for sixteen characters *viz.*, plant height (cm), number of leaves per plant, leaf length (cm), leaf width (cm), duration of crop (days), bolting (%), collar thickness (cm), neck thickness (cm), polar and equatorial diameter (cm), average bulb weight (g), average ten bulb weight (g), yield per plot (kg), yield per hectare (t), marketable bulb yield (t) and un-marketable bulb yield (t). The data was subjected to analysis of variance as per the statistical procedure.

Results and Discussion

Among different genotypes evaluated Super Flare, Super Red, Flare, Arka Bheem, Arka Lalima, Rampur Local and Marshall were revealed better growth with higher plant height, number of leaves, leaf length and leaf width at 30, 60 and 90 days after transplanting (DAT) compared to other genotypes grown during *Rabi* season (Table. 1a). While, Arka Bindu recorded lowest plant height and number of leaves during *Rabi*. Thus the increased plant height, leaf length, leaf width and number of leaves might have helped by better synthesis of carbohydrates and their utilization for build-up of new cells, apart from better absorption of nutrients for increased dry matter production in the plant. Besides, variations in vegetative parameters could be due to varietal characters governed by genetic factors. Of such variations in the growth of different genotypes were reported by several workers (Patil *et al.*, 1990^[11]; Gowda *et al.*, 1998^[1] Patil *et al.*, 1991^[12]; Mohanty and Prusti, 2001a^[8]; Mohanty and Prusti, 2002^[10]; Mahantesh, 2002^[5]; Mahantesh *et al.*, 2005^[7]; Sharma, 2009^[13] and Ram *et al.*, 2011^[14]).

A non-significant difference among the genotypes was observed with respect to per cent plant establishment at 30 DAT (Table.1b). The genotype Sataragarvha (92.73%) noticed the highest per cent plant establishment during *Rabi* season. While, lowest per cent of plant establishment documented in Suvarna during *Rabi* (81.61%) season. The percentage of plant establishment depends on the genotype, weather factors, soil type and soil moisture. In sometimes depends on the method of nursery raising, age and sturdiness of the seedlings.

An earliness is considered as one of the most important characters in any crop improvement programme. In most of the genotypes or accessions are preferred, when high yield is coupled with earliness. Moreover, duration of crop mainly depends on genotype. In the present study also identified certain genotypes having significant earliness with respect to days to maturity. The genotype Arka Bindu (97 days) had taken minimum number of days to harvest and Super Flare (112 days) took maximum number of days to harvest in *Rabi* season (Table. 1b). Similarly, Yadav *et al.*, 2009^[16] reported that cultivar Sindhudurg Local had taken less number of days (100.67 days), whereas maximum number of days to harvest documented in N-2-4-1 (120.67 days).

Of different genotypes Poona Furusungi, Agrifound Light Red, S-780, Light Red, Suvarna, Super Red and Arka Bheem were noticed no bolting percentage in *Rabi* season (Table. 1b). Whereas, Arka Bindu registered maximum bolting percentage in *Rabi* (9.85%). The bolting in onion mainly depends on genotype, temperature and seasonal effect. In onion, similar findings were obtained by Khar *et al.*, 2007^[4]; Yadav *et al.*, 2009^[16] and Trivedi and Dhumal, 2010^[15].

The reduced collar and neck thickness traits indirectly helps to increase the storage life and are therefore considered most important parameters in selecting onion genotypes for

extended storage life. In the present study, minimum collar thickness was observed in Arka Bindu (0.98cm) during *Rabi* season. While, maximum collar thickness was noticed in Super Flare (1.39cm). This may be due to high soil moisture or intermittent rainfall received at maturity of bulbs or even due to excess application of nitrogenous fertiliser or varietal characters. Similar findings were reported by Patil *et al.*, 1990^[11]; Gowda *et al.*, 1998^[1] Patil *et al.*, 1991^[12]; Mohanty and Prusti, 2001b; Mohanty and Prusti, 2002^[10]; Mahantesh, 2002^[5]; Mahantesh *et al.*, 2005^[7]; Sharma, 2009^[13] and Ram *et al.*, 2011^[14].

The minimum neck thickness was revealed in the Rampur Local in *Rabi* (0.43cm). However, maximum neck thickness was recorded in Super Flare in *Rabi* (0.72cm). The neck thickness of bulbs depends on genotype and also due to excess application of nitrogen for the crop. In sometimes, it is influenced by temperature and rainfall received during cropping period. Similar research findings were reported by Patil *et al.*, 1990^[11]; Gowda *et al.*, 1998^[1], Patil *et al.*, 1991^[12]; Mohanty and Prusti, 2001b; Mohanty and Prusti, 2002^[10]; Mahantesh, 2002^[5]; Mahantesh *et al.*, 2005^[7]; Sharma, 2009^[13] and Ram *et al.*, 2011^[14].

A synthetic hybrid Arka Bheem measured the highest polar diameter of bulb during *Rabi* (6.60cm) While, Arka Bindu registered lowest polar diameter during *Rabi* (4.20cm). With respect to equatorial diameter of onion hybrid Super Flare recorded maximum during *Rabi* (7.50cm). Whereas, Arka Bindu documented lowest equatorial diameter during *Rabi* (4.65cm). As these components influence on weight of the bulb, which ultimately contributes towards the bulb yield. The maximum growth and production of bulb could be attributed by better growth and vigour of the genotypes. As this helped in better synthesis and accumulation of photosynthates in the bulbs, which might be due to efficient metabolism, greater photosynthates mobilization, better source and sink relationship as explained by Sharma (2009)^[13]. Similar findings in onion were published by Mohanty and Prusti, 2002^[10]; Mahantesh, 2002^[5]; Mahantesh *et al.*, 2005^[7]; Khar *et al.*, 2007^[4]; Sharma, 2009^[13] and Ram *et al.*, 2011^[14].

The maximum average bulb weight was registered in onion hybrid Super Flare (132.50 g) during *Rabi*. However, Arka Bindu registered lowest average bulb weight during *Rabi* (39.30 g). The difference in bulb weight among different genotypes may be governed by genetic factors. An average ten bulb weight was noticed significantly maximum in the genotype Super Flare during *Rabi* (1322g). While, Arka Bindu recorded lowest ten bulb weight during *Rabi* (397 g). The variation in ten bulb weight among different genotypes might be due to difference in the weight and size of individual bulb and this might be due to genetic character of individual genotype. The genotype Flare documented the highest bulb yield per plot during *Rabi* season (6.85 kg/plot). However, Arka Bindu registered lowest bulb yield per plot during *Rabi* (3.52 kg/plot). The variation in the bulb yield per plot could be attributed from weight and size of different onion genotypes and this might be contributed towards the production of higher bulb yield per plot.

A total bulb yield per hectare recorded highest in hybrid Flare in *Rabi* season (38.50 t/ha). Whereas, Arka Bindu registered lowest bulb yield per hectare during *Rabi* (19.77 t/ha). The highest bulb yield production per hectare may be due to genetic yield potential of the variety. This may also be contributed by higher individual bulb weight and size, which might resulted in highest bulb yield. However, highest marketable bulb yield per hectare was recorded in Super Flare

during *Rabi* (37.23 t/ha). Whereas, Arka Bindu documented least marketable bulb yield than any other genotypes grown during *Rabi* (17.07 t/ha) season.

The highest yield of onion bulbs from these genotypes could be attributed due to maximum plant height and number of leaves, which are important components of growth. This might resulted in accumulation of maximum photosynthates in bulbs and also maximum plant establishment, which is directly proportional to number of bulbs produced. Apart from these, it may be due to maximum bulb polar diameter, bulb equatorial diameter and bulb weight, which are major yield contributing components. Moreover, hybrid vigour might contributed towards the production of larger bulbs with higher individual bulb weight, which may resulted in highest marketable bulb yield per hectare. Sharma (2009)^[13] reported that highest yield manifested by Baswant-780 was accompanied by better growth, larger size bulbs and maximum bulb weight. Thus, it could be concluded that bulb

yield is dependent on vigour of plant and yield components. The variations in the yields of different cultivars grown under similar conditions had been reported from several places by Jadhav *et al.*, 1990^[2]; Patil *et al.*, 1991^[12]; Katwale and Saraf, 1991^[3]; Mohanty and Prusti, 2002^[10]; Mahantesh, 2002^[5]; Mahantesh *et al.*, 2005^[7]; Khar *et al.*, 2007^[4]; Sharma, 2009^[13] and Ram *et al.*, 2011^[14].

The un-marketable bulb yield was minimum in onion hybrid Super Flare during *Rabi* (1.10 t/ha). However, Arka Bindu registered highest un-marketable yield per hectare during *Rabi* (2.70 t/ha). The highest un-marketable bulbs in Arka Bindu due to its genetical character and smaller size bulbs production.

In the present study based on the results, it is concluded that among all the genotypes Flare during *Rabi* season proved to be superior with considering the growth, yield and quality characteristics for cultivation under Eastern Dry Zone of Karnataka

Table 1a: Performance of onion genotypes for different morphological traits

Sl. No.	Genotypes	Plant height(cm)			Number of leaves per plant			Leaf length (cm)			Leaf width (cm)		
		30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
Varieties													
1	Arka Pragathi	43.85	56.00	59.65	6.20	9.10	10.85	39.95	51.22	54.45	0.79	1.16	1.22
2	Arka Kalyan	41.90	53.05	57.35	4.90	7.20	9.10	38.25	48.45	51.75	0.82	1.21	1.27
3	Arka Bindu	37.30	47.60	51.30	4.10	6.30	8.20	33.65	42.75	45.45	0.73	1.30	1.33
4	Arka Niketan	44.95	54.95	59.10	5.50	9.45	10.35	40.95	50.45	53.45	0.84	1.19	1.24
5	Nasik Red	45.05	55.95	60.85	5.60	9.25	10.10	41.12	51.75	55.05	0.89	1.22	1.28
6	Rampur Local	44.75	55.25	58.70	6.35	10.20	11.80	40.65	51.05	53.12	0.98	1.31	1.32
7	Bellary Red	43.55	52.95	57.35	6.45	10.10	11.25	39.75	48.85	51.75	0.87	1.10	1.22
8	Sataragarvha (check)	47.60	58.55	62.95	4.35	7.15	8.85	43.55	53.65	57.15	0.88	1.18	1.25
9	Poona Firusungi	48.10	57.65	61.60	6.80	10.20	12.40	43.92	53.05	55.95	0.92	1.28	1.31
10	Agrifound Light Red	42.95	53.15	56.45	4.45	7.25	8.75	38.95	48.85	50.75	0.83	1.18	1.26
11	S-780	47.95	58.25	62.35	6.90	11.30	12.85	43.75	53.35	56.55	0.98	1.33	1.37
12	Light Red	43.20	55.05	58.70	5.35	9.25	10.35	39.15	50.45	53.15	0.86	1.16	1.22
13	Prema-178	43.45	54.80	58.85	4.45	7.35	8.55	39.45	50.63	53.25	0.84	1.15	1.20
F1 hybrids													
14	Arka Kirthiman	47.30	58.00	62.00	5.65	9.85	10.70	43.15	53.85	56.25	0.90	1.21	1.27
15	Arka Lalima	47.80	58.80	63.85	6.85	11.35	12.15	43.75	54.54	58.65	0.92	1.23	1.29
16	Super Flare	52.15	62.90	67.50	7.10	12.10	13.20	48.05	58.75	62.25	0.98	1.37	1.4
17	Lucifer	46.40	57.30	61.35	5.36	9.75	10.40	42.55	53.24	55.95	0.89	1.24	1.28
18	BSS-827	48.75	59.85	64.15	5.10	9.25	10.30	44.45	55.35	58.45	0.93	1.28	1.31
19	Suvarna	43.75	55.75	59.30	4.76	7.15	8.45	39.65	51.55	54.15	0.82	1.14	1.18
20	Samruddhi	46.95	57.65	61.75	5.27	9.35	10.25	42.85	53.05	56.15	0.94	1.24	1.27
21	Sudharshan	43.00	54.25	58.50	4.45	8.35	9.40	39.12	49.95	53.14	0.83	1.22	1.24
22	Super Red	48.55	59.40	63.40	4.35	8.10	9.25	44.45	54.85	57.74	0.9	1.22	1.25
23	Flare	52.55	63.25	68.75	7.25	12.35	13.80	48.45	59.15	62.85	0.89	1.25	1.29
Synthetics													
24	Arka Bheem	50.15	61.15	65.10	6.45	10.35	11.50	46.35	56.95	59.95	0.86	1.23	1.24
25	Marshall	50.05	60.75	64.60	6.10	10.25	11.15	46.05	56.25	59.12	0.96	1.29	1.33
	Mean	46.08	56.89	61.02	5.60	9.29	10.56	42.08	52.48	55.46	0.88	1.23	1.27
	SEM±	1.98	2.12	2.17	0.38	0.59	0.78	2.42	1.97	2.54	0.04	0.05	0.06
	CD at 5%	5.79	6.20	6.34	1.12	1.73	2.27	NS	5.75	7.42	0.11	NS	NS
	CV (%)	6.09	5.28	5.03	9.70	9.02	10.40	NS	5.30	6.48	6.21	NS	NS

DAT: Days After Transplanting

Table 1b: Performance of onion genotypes for different morphological traits

Sl. No.	Genotypes	Plant establishment (%)	Duration of crop (Days)	Bolting (%)	Collar thickness (cm)	Neck thickness (cm)
Varieties						
1	Arka Pragathi	89.63	109.00	0.95 (5.56)	1.27	0.52
2	Arka Kalyan	84.57	103.00	1.75 (7.58)	1.29	0.57
3	Arka Bindu	88.76	97.00	9.85 (18.29)	0.98	0.48
4	Arka Niketan	86.32	110.00	1.45 (6.89)	1.24	0.52
5	Nasik Red	89.75	109.00	1.85 (7.81)	1.26	0.58
6	Rampur Local	88.46	107.00	2.25 (8.62)	1.19	0.43
7	Bellary Red	83.64	111.00	2.65 (9.36)	1.21	0.47
8	Sataragarvha (check)	92.73	107.00	1.25 (6.39)	1.31	0.61
9	Poona Furusungi	87.24	105.00	0.00 (0.40)	1.23	0.48
10	Agrifound Light Red	85.32	104.00	0.00 (0.40)	1.27	0.54
11	S-780	87.15	107.00	0.00 (0.40)	1.24	0.51
12	Light Red	87.48	105.00	0.00 (0.40)	1.15	0.47
F1 hybrids						
13	Prema-178	86.72	98.00	4.65 (12.43)	1.25	0.59
14	Arka Kirthiman	88.35	110.00	1.75 (7.57)	1.34	0.65
15	Arka Lalima	89.47	107.00	1.65 (7.36)	1.36	0.66
16	Super Flare	89.31	112.00	0.85 (5.25)	1.39	0.72
17	Lucifer	84.15	109.00	1.75 (7.58)	1.26	0.54
18	BSS-827	83.12	105.00	1.95 (7.98)	1.31	0.58
19	Suvarna	81.61	104.00	0.00 (0.40)	1.19	0.45
20	Samruddhi	83.16	106.00	2.88 (9.76)	1.34	0.64
21	Sudharshan	81.75	104.00	1.74 (7.56)	1.27	0.47
22	Super Red	82.65	109.00	0.00 (0.40)	1.29	0.58
23	Flare	90.16	111.00	1.22 (6.33)	1.35	0.66
Synthetics						
24	Arka Bheem	87.44	105.00	0.00 (0.40)	1.21	0.48
25	Marshall	86.42	109.00	1.45 (6.89)	1.23	0.51
	Mean	86.61	107.00	1.68	1.26	0.55
	SEm±	3.81	2.47	0.19	0.05	0.04
	CD at 5%	NS	7.20	0.56	0.14	0.13
	CV (%)	NS	7.28	16.08	5.53	11.18

Values in parenthesis are Arc sin transformed

Table 2: Performance of onion genotypes for yield and yield parameters

Sl. No.	Genotypes	Polar diameter (cm)	Equatorial diameter (cm)	Average bulb weight (g)	Average ten bulb weight (g)	Yield per plot (Kg/plot)	Yield per hectare (t/ha)	Marketable yield (t/ha)	Unmarketable yield (t/ha)
Varieties									
1	Arka Pragathi	5.10	5.80	92.70	935.00	5.86	32.92	31.40	1.52
2	Arka Kalyan	4.45	5.70	88.40	890.00	5.07	28.50	27.14	1.36
3	Arka Bindu	4.20	4.65	39.30	397.00	3.52	19.77	17.07	2.70
4	Arka Niketan	4.80	6.40	94.20	942.00	5.38	30.26	28.43	1.83
5	Nasik Red	5.30	6.10	96.50	984.00	6.23	35.00	33.34	1.66
6	Rampur Local	5.50	6.70	105.30	1075.00	6.08	34.16	32.71	1.45
7	Bellary Red	5.60	6.10	95.50	974.00	5.81	32.64	30.78	1.86
8	Sataragarvha (check)	4.75	5.85	90.40	918.00	4.89	27.50	25.77	1.73
9	Poona Furusungi	5.65	6.50	108.30	1105.00	6.36	35.73	34.53	1.87
10	Agrifound Light Red	5.30	6.20	86.40	878.00	4.71	26.50	24.73	1.77
11	S-780	5.65	6.50	104.60	1084.00	6.47	36.40	34.63	1.10
12	Light Red	4.90	5.60	82.60	806.00	5.39	30.33	29.01	1.32
13	Prema-178	5.20	6.20	89.10	898.00	4.62	26.00	24.04	1.96
F1 hybrids									
14	Arka Kirthiman	5.55	6.30	93.20	942.00	5.78	32.50	31.13	1.37
15	Arka Lalima	5.85	6.10	97.60	988.00	6.33	35.60	34.63	1.22
16	Super Flare	5.95	7.50	132.50	1322.00	6.58	37.00	35.90	1.10
17	Lucifer	5.45	6.30	98.20	993.00	5.85	32.86	31.09	1.77
18	BSS-827	4.80	6.20	85.30	842.00	5.51	31.00	29.57	1.43
19	Suvarna	4.85	5.90	84.10	833.00	4.30	24.16	22.70	1.46
20	Samruddhi	5.10	5.90	101.30	1008.00	5.41	30.40	29.25	1.15
21	Sudharshan	4.80	5.90	76.50	756.00	5.14	28.90	27.54	1.36
22	Super Red	4.65	6.40	84.50	853.00	5.31	29.83	28.41	1.42
23	Flare	5.25	6.60	96.40	992.00	6.85	38.50	37.03	1.47
Synthetics									
24	Arka Bheem	6.60	6.00	108.50	1103.00	6.20	34.83	33.60	1.23
25	Marshall	5.35	6.80	105.20	1085.00	6.04	33.73	32.44	1.29
	Mean	5.22	6.17	93.46	944.12	5.59	31.40	29.87	1.54
	SEm±	0.25	0.27	5.45	73.00	0.31	3.00	3.01	0.12
	CD at 5%	0.73	0.80	15.92	213.08	0.92	8.76	8.79	0.36
	CV (%)	6.78	6.26	8.25	10.94	7.96	13.52	14.25	11.39

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